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(54) **Improved rinse aid compositions**

(57) The present invention relates to rinse aid compositions comprising low foaming non-ionic surfactants, polycarboxylate polymers and, if wanted, hydrotropes and certain phosphate esters or certain alkyl iminodialkanoates.

EP 0 851 021 A2

Description

This invention relates to stable rinse aid compositions containing certain low foam nonionic surfactants, polycarboxylate polymers and, if wanted, hydrotropes and certain phosphate esters or certain alkyl iminodialkanoates. Further, the invention relates to a method for improving the stability and the hard water performance of a rinse aid composition containing the above components.

Rinse aid formulations generally are aqueous solutions containing nonionic surfactants which promote rapid draining of water from dishware and minimize spotting-and-filming. Under conditions of high total dissolved solids or under conditions of hard water, surfactants alone will not prevent filming. It is known that polymers of acrylic acid can improve the performance of rinse aid compositions by inhibiting deposition of mineral salts which contribute to filming of dishware.

For example, EP-B 308 221 discloses a rinse aid composition containing a low foam nonionic surfactant, an acrylic acid polymer of molecular weight 1000 to 250,000, and an additional nonionic surfactant having a cloud point of at least 70°C to serve as a stabilizer. The present invention differs from the EP-B 308 221 disclosure because the stabilizer surfactant is not needed and only certain specific polymers of acrylic acid are useful.

US 4,678,596 (US'596) discloses a rinse aid composition containing a low foam nonionic surfactant, a low molecular weight poly(meth)acrylic acid, and a high molecular weight stabilizing polymer of methacrylic acid. US'596 teaches that "a major obstacle exists to the use of low molecular weight polyacrylic acids in rinse aids due to the incompatibility of these polymers in aqueous rinse aid formulations containing low foam surfactants" (see US'596 at Column 2, lines 10-25).

Finally, US-A 3,941,713 (US'713) discloses a rinse aid composition comprising: (a) 3 to 30% low foaming nonionic surfactant, (b) 0.5 to 10% monoalkylphosphate ester and (c) 35 to 80% lactic, citric or glutaric acid or mixtures thereof. Further, said US'713 composition is useful for imparting a non-stick effect to aluminum articles by laying a temporary film on the aluminum article.

Finally, US-A 4,203,872 and US-A 4,264,479 disclose surfactant compositions comprising: (a) 25-75% nonionic surfactant, (b) 5-65% amphoteric detergent such as an alkylaminodipropionate, (c) 8-50% quaternary ammonium halide, (d) water. Said compositions are useful in preparing cleaners and degreasers, glass and smooth surface cleaners, wax and floor finish strippers, and soap film removers.

Applicants have surprisingly discovered that the addition of certain low molecular weight polymers of acrylic acid dramatically reduces the filming of glassware under hard water conditions, and the composition does not require a high cloud point nonionic surfactant or a high molecular weight compatibilizing polymer for stability.

Applicants have surprisingly discovered that the addition of certain phosphate esters better stabilize rinse aid compositions without the need for a high cloud point nonionic surfactant or compatibilizing polymer for stability.

Applicants have surprisingly discovered that the addition of certain alkyl iminodipropionates better stabilizes rinse aid compositions without the need for a high cloud point nonionic surfactant or compatibilizing polymer for stability.

Therefore, the present invention relates to a rinse aid composition having enhanced spotting and filming reducing properties comprising:

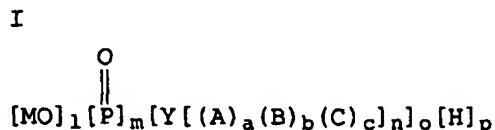
(a) 5 to 95% of low foaming nonionic surfactants,

(b) 0 to 90% hydrotropes and

(c) 0.1 to 12% polycarboxylate polymers.

In a preferred embodiment, the said rinse aid composition comprises:

(d) 0.1 to 15% phosphate esters selected from Formula I, II, III, or IV or mixtures thereof wherein:

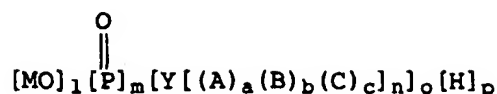


wherein $l = 0-2.9$,

$m = 0.1-1$, $n = 1$, $o = 0.1-3$, and $p = 0-0.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetraethylene oxide and mixtures thereof; $a = 0-30$, $b = 0-30$, $c = 0-30$, M is H, alkali metal, or mixtures thereof; Y is a saturated or unsaturated, linear or branched, cyclic or acyclic, substituted or unsubstituted alcohol having from 1 to

30 carbon atoms and mixtures thereof,
or

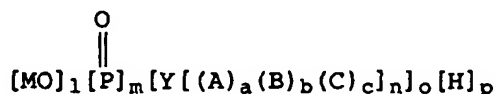
II



wherein $l = 0-5.9$,

$m = 0.1-2$, $n = 2$, $o = 0.1-6$, and $p = 0-1.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-100$, $b = 10-250$, $c = 0-100$, M is H, alkali metal, or mixtures thereof; Y is a diol having from 2 to 30 carbon atoms, linear or branched, including but not limited to ethylene glycol, diethylene glycol, propylene glycol, and 1, 10-decane diol or Y is an alkyl, aryl or alkylaryl primary amine including but not limited to tallow amine or aniline,
or

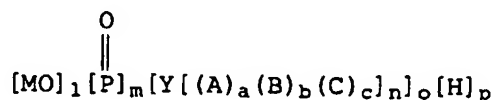
III



wherein $l = 0-8.9$,

$m = 0.1-3$, $n = 3$, $o = 0.1-9$, and $p = 0-2.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-120$, $b = 10-350$, $c = 0-100$, M is H, alkali metal, or mixtures thereof; Y is the residue of an organic compound having three reactive hydrogens which are attached to oxygen, nitrogen or sulfur atoms and mixtures thereof,
or

IV



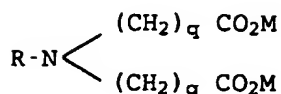
wherein $l = 0-11.9$,

$m = 0.1-4$, $n = 4$, $o = 0.1-12$, and $p = 0-3.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-150$, $b = 20-500$, $c = 0-150$, M is H, alkali metal, or mixtures thereof; Y is a tetrafunctional initiator containing reactive hydrogens attached to oxygen, nitrogen or sulfur atoms and mixtures thereof.

Preferably said phosphate ester (d) is selected from Formula I, Y is a C_{10-12} alcohol with about 2 moles PO (propylene oxide) and about 13 moles EO (ethylene oxide) added concurrently to yield a heteric oxide block reacted with polyphosphoric acid; and $b=0$, $c=0$.

Preferably said phosphate ester (d) is also selected from Formula II, Y=propylene glycol, $b=62$ and $a=39$, and $c=0$. In another preferred embodiment, the said rinse aid composition comprises:

(i)



wherein $q = 0-10$, $M=H$, alkali metal, or mixtures thereof, R = straight or branched, saturated or unsaturated, aliphatic hydrocarbon group having about 1 - 18 carbon atoms selected from the group consisting of lauryl, tridecyl, pentadecyl, palmityl, tallow, coco, soya, and linoleyl and mixtures thereof, or

(ii) beta-alanine, N-(2-carboxy ethyl)-N-(2-ethyl hexyl)-mono alkali metal salt.

In another preferred embodiment, said polycarboxylate polymers (c) are selected from polymers of acrylic acid having a molecular weight of 500 to 2500, more preferably of 500 to 2000, most preferably of 500 to 1500.

In another preferred embodiment, said hydrotropes (b) are present in the rinse aid composition at a level of 0.1% or more.

The present invention also relates to a method for reducing spotting and filming of dishware comprising contacting said dishware with the above rinse aid composition.

The rinse aid composition of the present invention is prepared by blending the mentioned components according to methods known to those skilled in the art.

SURFACTANTS

Low Foaming Nonionic Surfactants

The rinse aid compositions of the present invention contain low foaming nonionic surfactants at levels of 5 to 95% by weight, preferably 5 to 60% by weight; most preferably 10 to 40% by weight. Nonionic surfactants can be broadly defined as surface active compounds which do not contain ionic functional groups. An important group of chemicals within this class are those produced by the condensation of alkylene oxide groups (hydrophilic in nature) with an organic hydrophobic compound; the latter is aliphatic or alkyl aromatic in nature. The length of the hydrophilic or polyoxy-alkylene radical which is condensed with any particular hydrophobic group can be readily adjusted to yield a water-soluble compound having the desired degree of balance between hydrophilic and hydrophobic elements. Illustrative but not limiting examples of the various chemical types of suitable nonionic surfactants include:

(1) polyoxyethylene or polyoxypropylene condensates of aliphatic carboxylic acids, whether linear- or branched-chain and unsaturated or saturated, containing from about 8 to about 18 carbon atoms in the aliphatic chain and incorporating from 5 to about 50 ethylene oxide or propylene oxide units. Suitable carboxylic acids include "coconut" fatty acids (derived from coconut oil) which contain an average of about 12 carbon atoms, "tallow" fatty acids (derived from tallow-class fats) which contain an average of about 18 carbon atoms, palmitic acid, myristic acid, stearic acid and lauric acid.

(2) polyoxyalkylene (polyoxyethylene or polyoxypropylene) condensates of aliphatic alcohols, whether linear- or branched-chain and unsaturated or saturated, containing from about 8 to about 24 carbon atoms and incorporating from about 5 to about 50 ethylene oxide or propylene oxide units. Suitable alcohols include the "coconut" fatty alcohol, "tallow" fatty alcohol, lauryl alcohol, myristyl alcohol and oleyl alcohol. INDUSTROL® DW5 surfactant is a preferred condensate of an aliphatic alcohol. INDUSTROL® DW5 surfactant is available from BASF Corporation, Mt. Olive, New Jersey.

(3) polyoxyalkylene (polyoxyethylene or polyoxypropylene) condensates of alkyl phenols, whether linear- or branched-chain and unsaturated or saturated, containing from about 6 to about 12 carbon atoms and incorporating from about 5 to about 25 moles of ethylene oxide or propylene oxide.

(4) Particularly preferred nonionic surfactants are selected polyalkylene oxide block copolymers. This class can include polyethoxylated polypropoxylated propylene glycol sold under the tradename "PLURONIC®" made by the BASF Corporation or polypropoxylated polyethoxylated ethylene glycol sold under the tradename "PLURONIC®" made by the BASF Corporation, Mt. Olive, New Jersey. The first group of compounds are formed by condensing ethylene oxide with a hydrophobic base formed by the condensation of propylene oxide with propylene glycol (see

U.S. Pat. No. 2,674,619). The hydrophobic portion of the molecule which, of course, exhibits water insolubility, has a molecular weight from about 1500 to 1800. The addition of the polyoxyethylene radicals to this hydrophobic portion tends to increase the water solubility of the molecule as a whole and the liquid character of the product is retained up to the point where the polyoxyethylene content is about 50 percent of the total weight of the condensation product. The latter series of compounds called "PLURONIC-R®" are formed by condensing propylene oxide with the polyethoxylated ethylene glycol condensate. This series of compounds is characterized by having an average molecular weight of about between 2000 and 9000 consisting of, by weight, from about 10 to 80 percent polyoxyethylene, and a polyoxypropylene portion having a molecular weight between about 1000 and 3100.

U.S. Patents Nos. 4,366,326, 4,624,803, 4,280,919, 4,340,766, 3,956,401, 5,200,236, 5,425,894 and 5,294,365, each incorporated by reference herein, describe in detail nonionic surfactants useful in the practice of this invention.

Finally, Surfactant Science Series, edited by Martin J. Schick, nonionic Surfactants, Vols. 19 and 23 provide detailed description of nonionic surfactants and are incorporated by reference herein.

Other Surfactants Useful In the Compositions of the Present Invention

The rinse aid compositions herein may also contain surfactants selected from the group of organic surfactants consisting of anionic, cationic, zwitterionic and amphoteric surfactants, and mixtures thereof. Said other surfactants are present at a level of 0 to 100% by weight, preferably 1 to 80% by weight, most preferably, 5 to 60% by weight. Surfactants useful herein are listed in U.S. Pat. No. 4,396,520 Payne et al., issued August 2, 1983, U.S. Pat. No. 3,664,961, Norris, issued May 23, 1972, and in U.S. Pat. No. 3,919,678, Laughlin et al., issued December 30, 1975, each of which is incorporated herein by reference. Useful cationic surfactants also include those described in U.S. Pat. No. 4,222,905, Cockrell, issued September 16, 1980, and U.S. Pat. No. 4,239,659, Murphy, issued December 16, 1980, both incorporated herein by reference.

Useful anionic surfactants include the water-soluble salts, preferably the alkali metal, ammonium and substituted ammonium salts, of organic sulfuric acid reaction products having in their molecular structure of alkyl group containing from about 10 to about 20 carbon atoms and a sulfonic acid or sulfuric acid ester group. (Included in the term "alkyl" is the alkyl portion of acyl groups.) Examples of this group of synthetic surfactants are the sodium and potassium alkyl sulfates, especially those obtained by sulfating the higher alcohols (C₈-C₁₈ carbon atoms) such as those produced by reducing the glycerides of tallow or coconut oil; and the sodium and potassium alkylbenzene sulfonates in which the alkyl group contains from about 9 to about 15 carbon atoms in straight chain or branched chain configuration, e.g., those of the type described in U.S. Pat. Nos. 2,220,099 and 2,477,383 both of which are incorporated herein by reference. Especially valuable are linear straight chain alkylbenzene sulfonates in which the average number of carbon atoms in the alkyl group is from 11 to 13, abbreviated as C₁₁₋₁₃ LAS.

Other anionic surfactants suitable for use herein are the sodium alkyl glyceryl ether sulfonates, especially those ethers of higher alcohols derived from tallow and coconut oil; sodium coconut oil fatty acid monoglyceride sulfonates and sulfates; sodium or potassium salts of alkyl phenol ethylene oxide ether sulfates containing from about 1 to about 10 units of ethylene oxide per molecule and from about 8 to about 12 carbon atoms in the alkyl group; and sodium or potassium salts of alkyl ethylene oxide ether sulfates containing from about 1 to about 25 units of ethylene oxide per molecule and from about 10 to about 20 carbon atoms in the alkyl group.

Other useful anionic surfactants include the water-soluble salts of esters of alpha-sulfonated fatty acids containing from about 6 to 20 carbon atoms in the fatty acid group and from about 1 to 10 carbon atoms in the ester group; water-soluble salts of 2-acyloxy-alkane-1-sulfonic acids containing from about 9 to about 23 carbon atoms in the alkyl group and from about 8 to 20 carbon atoms in the moiety.

Particularly preferred surfactants herein are anionic surfactants selected from the group consisting of the alkali metal salts of C₁₁₋₁₃ alkylbenzene sulfonates, C₁₂₋₁₈ alkyl sulfates, C₁₂₋₁₈ alkyl linear polyethoxy sulfates containing from about 1 to about 10 moles of ethylene oxide, and mixtures thereof and nonionic surfactants that are the condensation products of alcohols having an alkyl group containing from about 9 to about 15 carbon atoms with from about 4 to about 12 moles of ethylene oxide per mole of alcohol.

Cationic surfactants, useful in the practice of the present invention, comprise a wide variety of compounds characterized by one or more organic hydrophobic groups in the cation and generally by a quaternary nitrogen associated with acid radical. Quaternary nitrogen compounds also include nitrogen-containing ring compounds. Suitable anions are halides, methyl sulfate and hydroxide. Tertiary amines can have characteristics similar to cationic surfactants at washing solutions with pH values less than about 8.5.

A more complete disclosure of cationic surfactants can be found in U.S. Pat. No. 4,228,044, issued October 14, 1980, to Cambre, said patent being incorporated herein by reference.

Amphoteric surfactants, useful in the practice of the present invention, include derivatives of heterocyclic secondary and tertiary amines in which the aliphatic moiety can be straight chain or branched, and wherein one of the aliphatic

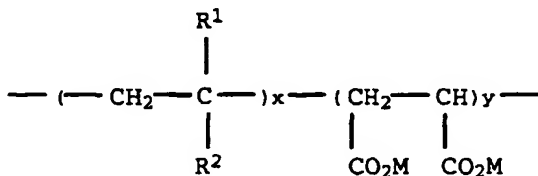
substituents contains from about 8 to 18 carbon atoms and at least one aliphatic substituent contains an anionic water-solubilizing group.

HYDROTROPES

The compositions of the present invention may contain hydrotropes. Hydrotropes useful in the present invention include but are not limited to sodium xylene sulfonate, sodium cumene sulfonate, hexylene glycol, propylene glycol, dihexyl sodium sulfonate, and short chain alkyl sulfates. U.S. Patents Nos. 3,563,901 and 4,443,270 disclose useful hydrotropes and are incorporated by reference herein. Dihexyl sodium sulfosuccinate is a particularly preferred hydrotrope. Hydrotropes are present at a level of 0 to 90% by weight, preferably at a level of 0 to 80% by weight, more preferably at a level of 0.1 to 90% or of 1 to 80% by weight and most preferably at a level of 10 to 60% or of 0.1 to 60% or of 0.1 to 10% by weight. Especially when alkyl iminodialkanoates (e) are present, hydrotropes should be added at a level of 0.1 to 90% by weights.

POLYCARBOXYLATE POLYMERS

The rinse aid compositions of the present invention also contain polycarboxylate polymers having a molecular weight of about 500 to 350,000 and the structural formula:



$\text{R}_1 = \text{H or CH}_3$; $\text{R}_2 = \text{CO}_2\text{M}$; $\text{M} = \text{H or alkali metal}$; $x = 7-1500$; $y = 0-1000$.

The polycarboxylates comprise homopolymers or copolymers of acrylic acid, methacrylic acid, maleic acid, fumaric acid, itaconic acid, and the like. They may be polyacrylic acid, polymethacrylic acid, or a copolymer of acrylic and methacrylic acids, said homopolymer or copolymer may range in molecular weight from about 500 up to about 350,000 depending on the degree of crosslinking.

While the preparation of polyacrylates from acrylic acid and methacrylic acid monomers is well known in the art and need not be detailed here, the following will illustrate the general technique that can be used.

The polymerization of acrylic acid to polyacrylate acid can be stopped at any appropriate molecular weight (determined by viscosity). The conditions under which it is polymerized will result in different performance characteristics for similar molecular weight polymers. If, for example, the polymerization took place under a condition of a high temperature (100°-150°C), there will be a strong tendency for crosslinking to occur. Crosslinking is undesirable as it decreases the apparent acid strength of the polyacid by preventing the expansion of the molecules, which would otherwise increase the separation between carboxylic groups. This results in two distinct adverse effects. First, the solubility of the polymer is reduced and, second, the chelation ability is reduced. It should be noted that the higher the molecular weight, the more likely extensive crosslinking occurs. It is, however, possible to produce polyacrylic acid having molecular weights in the millions without extensive crosslinking by reacting the monomers under very mild condition.

Water soluble salts of acrylic acid and methacrylic acid homo-polymers as described above are especially preferred for the purposes of the invention. The water soluble salt can be an alkali metal, ammonium or substituted (quaternary) ammonium salt. The alkali metal can be sodium or potassium. The sodium salt is preferred. The salt can be used in a partially or fully neutralized form. Also, partial neutralization and esterification of the carboxylic acid groups can be carried out while still retaining the effective properties of the homopolymer. The homopolymers are converted to the desired salt by reaction with the appropriate base, generally with a stoichiometric excess of the desired percent of conversion. Normally 100 percent of the carboxyl groups present will be converted to the salt, but the percentage can be less in certain situations. In general, the polycarboxylate polymers will have a molecular weight of from about 500 to 350,000, preferably about 500 to 70,000, even more preferably, about 1,000 to 20,000 and, most preferably, about 1,000 to 10,000.

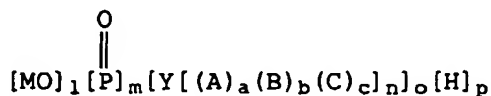
A preferred water soluble polycarboxylate polymer useful in the present invention is a sodium salt of polyacrylic acid, having a molecular weight of 500 to 350,000, more preferably 500 to 70,000, most preferably 1,000 to 20,000, even more preferably about 1,000 to 10,000. The polycarboxylate polymers are used at levels of 0.1 to 12% by weight, preferably 0.1 to 10% by weight, more preferably 0.1 to 8% by weight, most preferably 1 to 6% by weight.

In a preferred embodiment, especially when phosphate esters (d) and alkyl iminodialkanoates (e) are absent, the rinse aid compositions of the present invention contain low molecular weight polymers of acrylic acid. Specifically, the polymers useful in the practice of the invention are partially neutralized low molecular weight polymers of acrylic acid, having a preferred molecular weight range of about 500 to 2500, more preferably about 500 to 2000, and most preferably about 500 to 1500. Preferably, the low molecular weight polymers of acrylic acid are used at levels of 0.1 to 10% weight percent, more preferably 1 to 10% weight percent and most preferably 2 to 6% weight percent.

PHOSPHATE ESTERS

Finally, the rinse aid compositions of the present invention may contain phosphate esters selected from Formula I, II, III, or IV or mixtures thereof:

I



wherein $l = 0-2.9$,

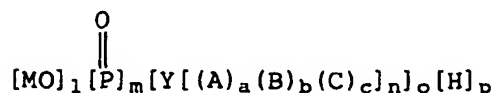
$m = 0.1-1$, $n = 1$, $o = 0.1-3$, and $p = 0-0.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 0-30$, $b = 0-30$, $c = 0-30$, M is H, alkali metal, or mixtures thereof; Y is a saturated or unsaturated, linear or branched, cyclic or acyclic, substituted or unsubstituted alcohol having from 1 to 30 carbon atoms and mixtures thereof.

| | | | | | |
|------------------|-----------------|-----------------|------------|---------------------|------------------------|
| Preferably, | $l=0-2.9$, | $m=0.1-1$, | $n=1$, | $o=0.1-3$, | and $p=0-0.9$. |
| More preferably, | $l=1-2.5$, | $m=0.3-0.9$, | $n=1$, | $o=0.5-2.0$, | and $p=0.1-0.7$. |
| Most preferably, | $l=1.5-2.2$, | $m=0.5-0.8$, | $n=1$, | $o=0.8$ to 1.5 , | and $p=0.2$ to 0.5 . |
| Preferably, | $a=0-30$, | $b=0$ to 30 , | $c=0-30$, | and $Y=1$ to 30 . | |
| More preferably, | $a=5$ to 20 , | $b=0-15$, | $c=0-15$, | and $Y=8-18$. | |
| Most preferably, | $a=10-18$, | $b=0-10$, | $c=0-10$, | and $Y=10-14$. | |

In the most preferred Formula I phosphate ester, Y is a C_{10-12} alcohol with about 2 moles PO and about 13 moles EO added concurrently to yield a heteric oxide block reacted with polyphosphoric acid; and $b=0$, $c=0$.

or

II



wherein $l = 0-5.9$,

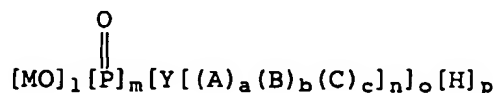
$m = 0.1-2$, $n = 2$, $o = 0.1-6$, and $p=0-1.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-100$, $b = 10-250$, $c = 0-100$, M is H, alkali metal, or mixtures thereof; Y is a diol having from 2 to 30 carbon atoms, linear or branched, including but not limited to ethylene glycol, diethylene glycol, propylene glycol, and 1, 10-decane diol or Y is an alkyl, aryl or alkylaryl primary amine including but not limited to tallow amine or aniline.

| | | | | | | |
|----|------------------|------------|------------|--------------|------------|----------------|
| 5 | Preferably, | l=0-5.9, | m=0.1-2, | n=2, | o=0.1-6, | and p=0-1.9. |
| | More preferably, | l=2-5.5, | m=0.6-1.8, | n=2, | o=0.5-4.0, | and p=0.2-1.4. |
| | Most preferably, | l=3.5-5.1, | m=1.0-1.6, | n=2, | o=0.9-2.5 | and p=0.4-1.0. |
| | Preferably, | a=15-100, | b=10-250, | and c=0-100. | | |
| 10 | More preferably, | a=20-70, | b=25-150, | and c=0-50. | | |
| | Most preferably, | a=30-50, | b=50-75, | and c=0-30. | | |

In the most preferred Formula II phosphate ester, Y = propylene glycol, b is about 62 and a is about 39, and c = 0.

or

III



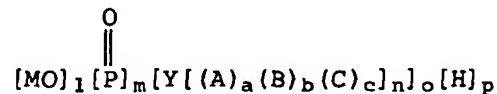
wherein l = 0-8.9,

m = 0.1-3, n = 3, o = 0.1-9, and p = 0-2.9, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; a = 15-120, b = 10-350, c = 0-100, M is H, alkali metal, or mixtures thereof; Y is the residue of an organic compound having three reactive hydrogens which are attached to oxygen, nitrogen or sulfur atoms and mixtures thereof.

| | | | | | | |
|----|------------------|------------|-------------|--------------|------------|-----------------|
| 35 | Preferably, | l=0-8.9, | m=0.1 to 3, | n=3, | o=0.1-9, | and p=0 to 2.9. |
| | More preferably, | l=5.0-8.5, | m=0.6-2.1, | n=3, | o=0.5-4.0, | and p=0.9-2.4. |
| | Most preferably, | l=6.5-8.1, | m=1.0-1.6, | n=3, | o=0.9-2.5, | and p=1.4-2.0. |
| | Preferably, | a=15-120, | b=10-350, | and c=0-100. | | |
| 40 | More preferably, | a=20-90, | b=25-250, | and c=0-50. | | |
| | Most Preferably, | a=30-70, | b=50-100, | and c=0-30. | | |

or

IV



wherein l = 0-11.9,

m = 0.1-4, n = 4, o = 0.1-12, and p = 0-3.9, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene M oxide and mixtures thereof; a = 15-150, b = 20-500, c = 0-150, M is H, alkali metal, or mixtures thereof; Y is a tetrafunctional initiator containing reactive hydrogens attached to oxygen, nitrogen or sulfur atoms and mixtures thereof.

| | | | | | | |
|----|------------------|-------------|------------|--------------|------------|----------------|
| 5 | Preferably, | l=0-11.9, | m=0.1-4, | n=4, | o=0.1-12, | and p=0-3.9. |
| | More preferably, | l=6.0-11.5, | m=0.5-2.5, | n=4, | o=0.4-6.0, | and p=1.5-3.5. |
| | Most preferably, | l=8.5-11.1, | m=1.0-2.0, | n=4, | o=0.9-3.5, | and p=2.0-3.0. |
| | Preferably, | a=15-150, | b=20-500, | and c=0-150. | | |
| 10 | More preferably, | a=40-120, | b=50-400, | and c=0-100. | | |
| | Most Preferably, | a=60-100, | b=100-350, | and c=0-60. | | |

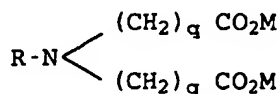
15 Examples include ethylene diamine, pentaerythritol, triethylene diamine, erythritol, hexamethylene diamine, phenylene diamine.

Preferably, the phosphate esters of Formula I, II, III and IV or mixtures thereof are used at levels of 0.1 to 15% by weight, more preferably at levels of 1 to 12% by weight, and most preferably at levels of 2 to 10% by weight.

20 ALKYL IMINODIALKANOATES

Finally, the rinse aid compositions of the present invention may contain as an alternative for the phosphate esters (d) alkyl iminodialkanoates having the following formula:

(i)



35 wherein q = 0-10, M = H, alkali metal such as Na or K, or mixtures thereof, R straight or branched, saturated or unsaturated, aliphatic hydrocarbon group having about 1-18 carbon atoms, such as lauryl, tridecyl, pentadecyl, palmityl, tallow, coco, soya, and linoleyl and mixtures thereof.

The most preferred alkyl iminodialkanoate (ii) is beta-alanine, N-(2-carboxyethyl)-N-(2-ethylhexyl)-monosodium salt (i.e. alkyl-imindipropionate).

Preferably, the range of alkyl iminodialkanoates is 0.1-20% by weight, more preferably 2-10% by weight.

40 The following Examples further describe and demonstrate the present invention and illustrate its utility. The Examples are given solely for the purpose of illustration, and are not to be construed as limitations of the present invention.

All percentage (%) values in the following Examples as well as in the preceding description of the present invention are by weight unless indicated otherwise.

45 Examples for rinse aid compositions based on components (a) and (c)

EXAMPLE 1

No rinse additive was used.

EXAMPLE 2

A commercial rinse aid composition believed to contain at least one block copolymer of ethylene oxide and propylene oxide.

EXAMPLE 3

A commercial rinse aid composition believed to contain at least one polyoxyalkylene condensate of an aliphatic

alcohol.

EXAMPLE 4 (the present invention)

5 The composition of Example 2 containing five percent by weight of a partially neutralized 1000 molecular weight polymer of acrylic acid.

EXAMPLE 5

10 The composition of Example 2 containing five percent by weight of a neutralized 1200 molecular weight polymer of acrylic acid.

EXAMPLE 6

15 The composition of Example 2 containing five percent by weight of a partially neutralized 8000 molecular weight polymer of acrylic acid.

EXAMPLE 7

20 The composition of Example 2 containing five percent by weight of a partially neutralized 7000 molecular weight polymer of acrylic acid.

EXAMPLE 8 (the present invention)

25 The composition of Example 3 containing five percent by weight of a partially neutralized 1000 molecular weight polymer of acrylic acid.

 The rinse aid compositions were evaluated for stability and effectiveness at minimizing spotting-and-filming on glassware in a household dishwasher.

30 **SPOTTING-AND-FILMING EVALUATION**

Detergent composition:

35 38% sodium tripolyphosphate hexahydrate

 20% sodium carbonate

 20% sodium metasilicate pentahydrate

40 22% sodium sulfate

Fat Soil:

45 72% margarine

 18% powdered milk

 5% lard

50 5% rendered beef tallow

 Five glasses were evaluated after three wash/rinse cycles using 250 ppm hardness water.

55 Cycle 1: 20 grams detergent per wash, 25 grams fat soil in pre-wash, 1 ml rinse aid in second rinse.

 Cycle 2: repeat cycle 1, add 12 grams powdered milk to main wash.

 Cycle 3: repeat cycle 1, add 15 grams raw egg to main wash.

The glasses were visually rated on a scale from one (spot and film free) to five (complete coverage of spots and film), see Table 1.

Tabelle 1

| Example | Stability | Spotting and Filming |
|---------|-----------|----------------------|
| 1 | N/A | 4.5 |
| 2 | N/A | 4.5 |
| 3 | N/A | 4.5 |
| 4 | stable | 2.5 |
| 5 | unstable | 2.5 |
| 6 | unstable | 4.2 |
| 7 | unstable | 4.0 |
| 8 | stable | 2.5 |

In conclusion, the rinse aid compositions of the present invention (Examples 4 and 8) are effective at minimizing the spotting-and-filming of glassware under hard water conditions and do not require additional surfactants and/or polymers to provide stability.

Example for rinse aid compositions based on components (a), (b), (c) and (d)

Detergent composition:

34% sodium tripolyphosphate

18% sodium carbonate

25.5% sodium metasilicate pentahydrate

15% caustic soda

2.5% chlorinated isocyanurate

5% water,

Soil:

80% margarine

20% powdered milk

Five glasses were evaluated after five wash/rinse cycles in a Hobart AM -11 dishwasher, using 1000 ppm total dissolved solids water containing 30% sodium sulfate, 30% sodium chloride, 40% sodium carbonate by weight.

Cycle 1: 163.5 grams detergent, 40 grams soil.

Cycle 2: 13.6 grams detergent, 40 grams soil.

Cycle 3: repeat Cycle 2.

Cycle 4: repeat Cycle 3.

Cycle 5: repeat Cycle 4.

The glasses were visually rated on a scale of from one (spot and film free) to five (complete coverage with spots and film).

EXAMPLE 9

A rinse aid composition of 10% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% by weight sodium xylene sulfonate hydrotrope, and 60% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

EXAMPLES 10

A rinse aid composition of 10% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% percent by weight sodium xylene sulfonate, 2% percent by weight of a partially neutralized 8000 molecular weight polymer of acrylic acid, and 58% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

EXAMPLES 11

A preferred rinse aid composition as described in US-A 3,941,713 consisting of: 67.5% lactic acid, 3.5% monoalkyl phosphate ester, 5.0% PLURAFAC® RA 40, 15.0% isopropanol and water to 100%.

EXAMPLE 12 (the present invention)

A rinse aid composition of 10% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% by weight sodium xylene sulfonate hydrotrope, 2% by weight of a partially neutralized 8000 molecular weight polymer of acrylic acid, 8% by weight of a phosphate ester and 50% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

Table 2 serves to illustrate the superior benefits of the present invention over the prior art.

TABLE 2

| EXAMPLE | APPERANCE | SPOTTING & FILMING |
|---------|-----------|--------------------|
| 9 | Clear | 4.5 |
| 10 | Cloudy | 2.7 |
| 11 | Clear | 4.2 |
| 12 | Clear | 3.3 |

In conclusion, the rinse aid compositions of the present invention are effective at minimizing the spotting-and-filming of glassware under high total dissolved solids conditions and do not require additional high cloud point nonionic surfactants and/or polymers to provide stability.

Example of rinse aid compositions based on components (a), (b), (c) and (e)

Detergent composition:

34% sodium tripolyphosphate

18% sodium carbonate

25.5% sodium metasilicate pentahydrate

15% caustic soda

2.5% chlorinated isocyanurate

5% water

Soil:

5 80% margarine

20% powdered milk

10 Five glasses were evaluated after five wash/rinse cycles in a Hobart AM-11 dishwasher, using 1000 ppm total dissolved solids water containing 30% sodium sulfate, 30% sodium chloride, 40% sodium bicarbonate by weight.

Cycle 1: 163.5 grams detergent, 40 grams soil.

Cycle 2: 13.6 grams detergent, 40 grams soil.

15

Cycle 3: repeat Cycle 2.

Cycle 4: repeat Cycle 3.

20 Cycle 5: repeat Cycle 4.

The glasses were visually rated on a scale of from one (spot and film free) to five (complete coverage spots and film).

25 EXAMPLE 13

A rinse aid composition of 10% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% by weight sodium xylene sulfonate hydrotrope, and 60% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

30

EXAMPLE 14

35 A rinse aid composition of 10% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% percent by weight sodium xylene sulfonate, 2% percent by weight of a partially neutralized 8000 molecular weight polymer of acrylic acid, and 58% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

EXAMPLE 15 (the present invention)

40 A rinse aid composition of 1.0% by weight of a 3100 molecular weight block copolymer of ethylene oxide and propylene oxide, 30% by weight sodium xylene sulfonate hydrotrope, 2% by weight of a partially neutralized 8000 molecular weight polymer of acrylic acid, 8% by weight of an alkyl iminodipropionate and 50% by weight deionized water. The rinse aid is injected at a rate such that the final rinse water contains 400 ppm rinse aid.

45 Table 3 serves to illustrate the superior benefits of the present invention over the prior art.

TABLE 3

| EXAMPLE | APPEARANCE | SPOTTING & FILMING |
|---------|------------|--------------------|
| 13 | Clear | 4.5 |
| 14 | Cloudy | 2.7 |
| 15 | Clear | 4.9 |

50

55 In conclusion, the rinse aid composition of the present invention (Example 15) is effective at minimizing the spotting-and-filming of glassware under high total dissolved solids conditions and do not require additional high cloud point nonionic surfactants and/or polymers to provide stability.

Claims

1. A rinse aid composition having enhanced spotting and filming reducing properties comprising:

(a) 5 to 95% of low foaming nonionic surfactants,

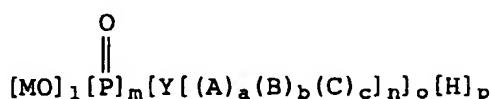
(b) 0 to 90% hydrotropes and

(c) 0.1 to 12% polycarboxylate polymers.

2. A rinse aid composition according to Claim 1 additionally comprising:

(d) 0.1 to 15% phosphate esters selected from Formula I, II, III or IV or mixtures thereof wherein:

I

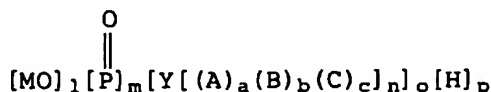


wherein $l = 0-2.9$,

$m = 0.1-1$, $n = 1$, $o = 0.1-3$, and $p = 0-0.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 0-30$, $b = 0-30$, $c = 0-30$, M is H, alkali metal, or mixtures thereof; Y is a saturated or unsaturated, linear or branched, cyclic or acyclic, substituted or unsubstituted alcohol having from 1 to 30 carbon atoms and mixtures thereof,

or

II

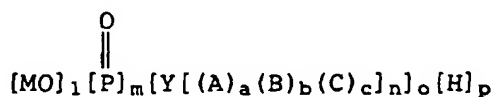


wherein $l = 0-5.9$,

$m = 0.1-2$, $n = 2$, $o = 0.1-6$, and $p = 0-1.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-100$, $b = 10-250$, $c = 0-100$, M is H, alkali metal, or mixtures thereof; Y is a diol having from 2 to 30 carbon atoms, linear or branched, including but not limited to ethylene glycol, diethylene glycol, propylene glycol, and 1,10-decane diol or Y is an alkyl, aryl or alkylaryl primary amine including but not limited to tallow amine or aniline,

or

III

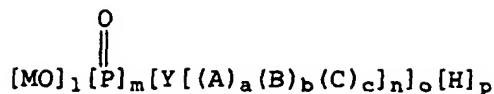


wherein $l = 0-8.9$,

$m = 0.1-3$, $n = 3$, $o = 0.1-9$, and $p = 0-2.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-120$, $b = 10-350$, $c = 0-100$, M is H, alkali metal, or mixtures thereof; Y is the residue of an organic compound having three reactive hydrogens which are attached to oxygen, nitrogen or sulfur atoms and mixtures thereof,

or

IV



wherein $l = 0-11.9$,

$m = 0.1-4$, $n = 4$, $o = 0.1-12$, and $p = 0-3.9$, A, B and C are ethylene oxide, propylene oxide, butylene oxide, tetramethylene oxide and mixtures thereof; $a = 15-150$, $b = 20-500$, $c = 0-150$, M is H, alkali metal, or mixtures thereof; Y is a tetrafunctional initiator containing reactive hydrogens attached to oxygen, nitrogen or sulfur atoms and mixtures thereof.

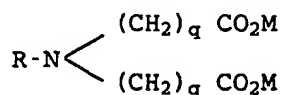
3. A composition according to Claim 2, wherein said phosphate ester (d) is selected from Formula I, Y is a C_{10-12} alcohol with about 2 moles PO and about 13 moles EO added concurrently to yield a heteric oxide block reacted with polyphosphoric acid; and $b = 0$, $c = 0$.

4. A composition according to Claim 2, wherein said phosphate ester (d) is selected from Formula II, Y = propylene glycol, $b = 62$ and $a = 39$, and $c = 0$.

5. A rinse aid composition according to Claim 1 additionally comprising:

(e) 0.1 to 15% alkyl iminodialkanoates having the following structures:

(i)



wherein $q = 0-10$, $M = H$, alkali metal, or mixtures thereof, R = straight or branched, saturated or unsaturated, aliphatic hydrocarbon group having about 1-18 carbon atoms selected from the group consisting of lauryl, tridecyl, pentadecyl, palmityl, tallow, coco, soya, and linoleyl and mixtures thereof, or

(ii) beta-alanine, N-(2-carboxy ethyl)-N-(2-ethyl hexyl)- mono alkali metal salt.

6. A rinse aid composition according to Claims 1 to 5, wherein said polycarboxylate polymers (c) are selected from polymers of acrylic acid having a molecular weight of 500 to 2500.

7. A rinse aid composition according to Claims 1 to 6, wherein said hydrotropes (b) are present at a level of 0.1% or more.

8. A method for reducing spotting and filming of dishware comprising contacting said dishware with a rinse aid composition as claimed in Claims 1 to 7.